

Claims

1. A voltage regulator comprising:

regulator means for receiving a sensed voltage
5 signal and for providing, in response to the effective
comparison of said sensed voltage signal with a reference
signal, a regulator output signal, comprising pulses,
having a predetermined frequency and a predetermined
signal characteristic determined in accordance with said
10 comparison;

drive circuit means coupled to said regulator
means and comprising a power switching device having a
control terminal effectively coupled to said regulator
output signal and having at least two output terminals,
15 said output terminals coupled in series with a control
element of a voltage control means, which determines said
sensed voltage signal, ~~between~~ ^{across} a maximum power source
voltage potential, said drive circuit means controlling
said sensed voltage, via said control means, in
20 accordance with said characteristic of said regulator
output signal to maintain said sensed voltage signal at a
predetermined voltage level determined by said reference
signal, said drive circuit means including a peak voltage
increasing means for receiving said regulator output
25 signal and effectively providing in response thereto a
corresponding increased magnitude voltage signal
generally varying as said regulator output signal but
varying up to a peak voltage potential in excess of said
maximum power source voltage potential,

30 wherein the improvement comprises said peak
voltage increasing means comprising a capacitor
selectively series coupled and decoupled ~~between~~ ^{across} a
predetermined power source voltage potential in
accordance with pulses of a high frequency signal having
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a pulse frequency substantially in excess of the
frequency of said regulator output signal, said peak
voltage increasing means, therefore, comprising a high
frequency charge pump which provides said increased
5 voltage signal, said increased voltage signal having the
same general waveform as said regulator output signal but
increased in voltage magnitude to achieve a peak voltage
potential in excess of said maximum power source voltage
potential, the charge pump providing said increased
10 voltage signal as an output which is coupled to said
control terminal of said power switching device.

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2. A voltage regulator according to claim 1 wherein said predetermined characteristic of said regulator output signal, which characteristic is determined in accordance with said comparison, comprises duty cycle.

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3. A voltage regulator according to claim 2 wherein said drive circuit means includes means for selectively preventing said series coupling of said capacitor ~~between~~ ^{across} said predetermined power source voltage potential during duty cycle portions of said regulator output signal of a predetermined polarity and permitting said series coupling during duty cycle portions of said regulator output signal of an opposite predetermined polarity.

4. A voltage regulator according to claim 3 wherein said predetermined power source voltage potential that said capacitor is selectively series coupled and decoupled ~~between~~ ^{across} substantially comprises said maximum power source voltage potential that said power switching device and control element of said voltage control means are coupled ~~between~~ ^{across}.

5. A voltage regulator according to claim 4 wherein the frequency of said high frequency signal pulses is at least one order of magnitude higher than the frequency of said regulator output signal.

6. A voltage regulator according to claim 5 wherein said preventing means of said drive circuit means includes a first switch device which selectively couples a first terminal of said capacitor to a first predetermined voltage in accordance with duty cycle portions of said regulator output signal of a predetermined polarity and decouples said first terminal

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during duty cycle portions of said regulator output
signal of an opposite predetermined polarity, and wherein
said peak voltage increasing means of said drive circuit
means includes a second switch device which selectively
5 series couples and decouples a second terminal of said
capacitor to a second predetermined voltage, different
from said first predetermined voltage, in accordance with
said pulses of said high frequency signal.

10 7. A voltage regulator according to claim 6 wherein
said drive circuit means includes a third switch device
which selectively couples and decouples said one
capacitor terminal to said second voltage potential in
accordance with said regulator output signal.

15 8. A voltage regulator according to claim 1 wherein
said drive circuit means includes a first switch device
which selectively couples a first terminal of said
capacitor to a first predetermined voltage in accordance
20 with duty cycle portions of said regulator output signal
of a predetermined polarity and decouples said first
terminal during duty cycle portions of said regulator
output signal of an opposite predetermined polarity, and
wherein said peak voltage increasing means of said drive
25 circuit means includes a second switch device which
selectively series couples and decouples a second
terminal of said capacitor to a second predetermined
voltage, different from said first predetermined voltage,
in accordance with said pulses of said high frequency
30 signal.

35 9. A voltage regulator according to claim 8 wherein
said drive circuit means includes a third switch device
which selectively couples and decouples said one

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capacitor terminal to said second voltage potential in accordance with said regulator output signal.

10. A voltage regulator according to claim 9
5 wherein said first capacitor terminal is coupled to said power switching device control terminal through a peak rectifying diode.

11. A voltage regulator according to claim 10
10 wherein said first predetermined voltage is coupled to said first capacitor terminal through a diode.

12. A voltage regulator according to claim 11
15 wherein said power switching device comprises an FET having gate, drain and source electrodes corresponding to said control and output terminals, respectively.

13. A voltage regulator according to claim 12
20 wherein said drain electrode is coupled to a source of constant voltage potential and wherein the effective internal capacitance of said FET between said gate and source electrodes is substantially larger than the capacitance of said capacitor.

14. A voltage regulator according to claim 13
25 wherein said voltage control means comprises a voltage generator means and wherein said control element of said voltage control means comprises a field coil.

15. A voltage regulator according to claim 1
30 wherein said voltage control means comprises a voltage generator means and wherein said control element of said voltage control means comprises a field coil.

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16. A voltage regulator according to claim 15
wherein said voltage generator means includes stator
windings, in addition to said field coil, and a rectifier
circuit means for receiving the output of said stator
5 windings and providing a charging signal for a battery so
as to maintain a predetermined battery voltage
thereacross.

17. A voltage regulator according to claim 16
10 wherein said predetermined voltage across said battery
corresponds to said predetermined maximum power source
voltage potential.

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